

### ABSTRACT

A modulator/demodulator apparatus and method for applications, such as communications, active sensing and navigation is disclosed. The modulator time-delays and time-scales (compresses or dilates) an arbitrary, noise-like "base signal," then it sums this time-scaled and time-delayed version of the base signal with the original base signal to create a "signal pair" or doublet. The two signals in the doublet are completely overlapped in time and frequency. This doublet creation process can be repeated (with different base signals and/or different time-scale/time-delay parameters) and multiple doublets can be summed together and simultaneously transmitted. This demodulator uses the applied differential time-scale and differential time-delay to extract information, such as a message or a radar image, from the doublet.

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